LOSS OF SHELL EFFECTS AT FINITE ROTATIONAL FREQUENCY*

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We have tried to understand in a systematic way the contribution of shell effects to nuclear moments of inertia at high spins, both at zero and finite temperature. These shell effects are manifested in the deviation of the moments of inertia from the rigid-body values and by non-zero shell energies. The semiclassical Periodic Orbit Theory (POT) calculates these shell effects in terms of contributions from classical periodic orbits in a spheroidal cavity of the same shape as that of the nucleus. POT is ideally suited for this since the contributions of only the shortest orbits (triangles and rhombi) are sufficient to understand the variations with neutron number of the quantities of interest, making it possible to extract generic features (e.g., dependence on shape). Strutinsky-type shell energies as well as deviations from rigid-body moments of inertia are calculated both semiclassically and quantum mechanically and have been shown [1] to fit the experimental values.

In this abstract, we show that the rotation 'damps the shell effects' (see figure). The shell energies are calculated for a cavity as a function of deformation α (close to ϵ) and neutron number N for rotational frequencies of 0.3 MeV (left) and 0.6 MeV (right) . The contour plots are from quantum mechanical calculations (cranked Woods-Saxon potential with very small diffuseness). The lines are obtained from POT for the rhombi. The downsloping solid (dashed) lines are the loci of minimum (maximum) shell energies from orbits in the planes containing the symmetry axis. These orbits are the main contributors to the shell effects, i.e., the structure at 0.3 MeV is dominated by the downsloping lines. In contrast, the structure at 0.6 MeV is clearly dominated by the upsloping lines, which are for equatorial (in plane $\perp$ to the symmetry axis) orbits. POT predicts that this is precisely the effect of the rotation [1], i.e., the main shell effect is destroyed. This mechanism will be explained.

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